Quality Concerns of Indian Fishery Exports as Indicated by the import alerts by European Union and the United States :Steps to Mitigate Recurrence

B. MADHUSUDANA RAO[1*], P. VIJI[1], D. JESMI[1], M.M.PRASAD[1] and C.N. RAVISHANKAR[2]

[1]Visakhapatnam Research Centre of ICAR-Central Institute of Fisheries Technology (ICAR-CIFT), Ocean View Layout, Pandurangapuram,Visakhapatnam-530003, Andhra Pradesh

[2]ICAR-Central Institute of Fisheries Technology (ICAR-CIFT), CIFT Junction, Matsyapuri, P.O., Kochi-682 029, Kerala.

Corresponding author email : *bmrcift@gmail.com

Abstract

Indian fishery exports have increased phenomenonly in the last ten years and for the first time crossed 10 lakh tonnes in 2014-15. However, quality concerns of fish (finfish, crustaceans and cephalopods) exported from India have been raised by the European Union and United States. This article examines the different quality issues raised by the EU and US so as to enable us take stock of the situation and adopt preventive measures to avoid recurrence of quality lapses.

Seafood export from India is witnessing a phenomenal growth over the last few years. Indian fishery exports grew impressively, from 4,61,329 tonnes in 2004-2005 to 10,51,243 tonnes in 2014-15. In terms of value, the increase was from 6647 crores in 2004-2005 to Rs. 33,441 crores in 2014-15. It is pertinent to observe that till 2013-14, frozen fin fish and frozen shrimp were the major items of export in terms of quantity and value, respectively whereas in 2014-15, frozen shrimp became the major item of export, both quantity wise (3,57,505 tonnes) and value wise (Rs. 22,468 crores) indicating the preeminence of shrimp in Indian exports (Fig 1). In 2013-14, the quantity of frozen fish exported from India was 3,24,359 tonnes which reduced to 3,09,434 tonnes in 2014-15 while frozen shrimp export increased from 3,01,435 to 3,57,505 tonnes during the same period.

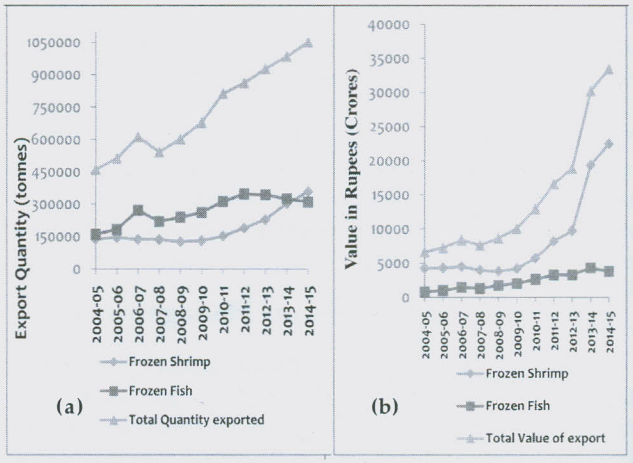

Fig 1 Fishery products exported from India during 2004-05 to 2014-2015

The substantial increase in the quantity of frozen shrimp can be squarely attributed to the introduction of Pacific white shrimp, *Litopenaeus vannamei* and exponential farming of the same by Indian farmers, particularly in the State of Andhra Pradesh. It can be observed from Fig 1 (a & b) that the share of frozen shrimp in the Indian fishery exports rose significantly after 2009-10, the year in which *L. vannamei* culture was initiated by the farmers

of Andhra Pradesh. Andhra Pradesh is the leading producer of cultured shrimp with a production of 2,79,727 MT and shrimp culture is expanding in other States such as Tamil Nadu, Gujarat and Odisha, thus establishing the importance of shrimp as primary export commodity.

Table 1. *Litopenaeus vannamei* production in India

Year	*L. vannamei* Production (MT)
2009-10	1,731
2010-11	18,237
2011-12	80,727
2012-13	1,47, 516
2013-14	1,75,071

Frozen shrimp has been the mainstay of India fishery exports and the share of cultured shrimp to the total shrimp export in 2014-15 was 76.45% (in terms of US$). The United States (USA) with 1,12,702 MT was the largest importer of frozen shrimp from India followed by the European Union (81,952 MT).

Quality standards are key tools that are employed to avert food safety risks in food before it can harm the consumers. The 'huge volumes' of fish farmed/harvested and processed would be worth 'nothing' if they fail to meet the quality standards laid down by the national and international food safety agencies. Quality that encompasses safety has been and would continue to be the prime yard stick applied by both, importing countries and national food safety agencies for accepting food products including fishery products for human consumption. An understanding of the specific quality issues reported in fishery products exported by India would provide focused direction to avoid recurrence. Regulatory requirements for fish quality have been laid both for sale within the country (FSSAI) and for export by the national authorities (Export Inspection Council of India (EIC) and the importing countries [European Union (EU) Directives , US Food and Drug Administration (USFDA), Specific requirements for Russia, Japan, Australia etc]. Rapid Alert System for Food and Feed (RASFF) notifications pertaining to fish exported from India during 2001-2015 to European Union (https://webgate.ec.europa.eu/rasff-window/portal/event) and import alerts pertaining to fish exported from India that were notified by the US Food and Drug Administration during 2010-2015, http://www.fda.gov/ForIndustry/ImportProgram/ImportAlerts/default.htm were accessed and analysed.

Quality issues raised by the European Union in fish exported from India

RASFF of the EU is a key tool that is used to avert food safety risks in food and feed before they can harm consumers. Alert notifications are sent when a serious risk presented by food and feed is available in the market and when rapid action is required. Over the last fifteen years (2001-2015), a total of 362 RASFF notifications related to fishery exports from India to the EU were notified. Higher incidence of quality issues were associated with crustaceans (71%) compared to cephalopods (15%) and finfish (14%).

The quality issues that were notified in fish exported from EU include physical, chemical and biological hazards (Table 2). The major quality issue responsible for RASFF notifications was veterinary medicinal products (52%), followed by heavy metals (14.4%) and the presence of pathogenic microorganisms (12.4%) (Fig 2) indicating the need for focused action on these three quality issues. The residues of veterinary medicinal products (antibiotics) detected in fish exported from India were Furazolidone (AOZ); Nitrofurazone (SEM), Oxytetracycline and Chloramphenicol. The heavy metals, cadmium and mercury and the pathogenic bacteria Vibrios sp (*Vibrio cholerae*/ *Vibrio cholerae* non-O1/ non-O139, *Vibrio parahaemolyticus*, *Vibrio vulnificus*) and Salmonella (*Salmonella paratyphi* B; *Salmonella weltevreden*) were also reported in fish exported from India. However, there was a dominance of specific quality issue depending on the fish species (Fig 3). The major quality concerns associated with crustaceans was attributed to residues of veterinary medicinal products (72%) and pathogenic microorganisms (14%) whereas with cephalopods it was heavy metals (80%). However, in the case of fin fish, the quality issues were diverse *viz.*, biocontaminants (33%), heavy metals (18%), pathogenic microorganisms (12%), food additive & flavourings (12%), non-pathogenic microorganisms (6%) and organoleptic aspects (6%).

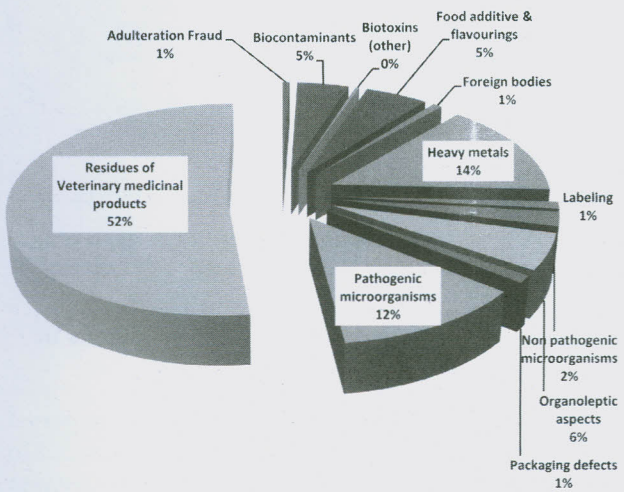

Fig 2. RASFF notifications (as %) of fishery products exported from India to the EU during 2001-2015

Table 2: Quality issues responsible for RASFF alerts of fish exported from India to the EU

Hazard Category	Specific cause for RASFF alert
Adulteration Fraud	improper health certificate
Biocontaminants	histamine
Biotoxins (other)	ciguatera poisoning
Food additive & flavourings	Sodium carbonate, sulphite, allura red, sorbic acid, E160b annato/ bixin/norbixin; E122 Azorubine; sulphite
Foreign bodies	Faeces; defective packaging and infested with insects, foreign body (scraps of paper, cardboard, wire wool, hair and insects)
Heavy metals	Cadmium, mercury
Labeling	Insufficient/ incorrect labeling
Non pathogenic microorganisms	high aerobic plate count, thermotolerant Coliforms, Enterococci, *Enterobacteriaceae*
Organoleptic aspects	Altered organoleptic characteristics and abnormal smell; spoilage and poor temperature control
Packaging defects	Defective packaging and infested with insects; bulging
Pathogenic microorganisms	Vibrios (*Vibrio cholerae*/ *Vibrio cholerae* NON O:1/NON O:139), *Vibrio parahaemolyticus, Vibrio vulnificus, V. alginolyticus*). Salmonella (*Salmonella paratyphi* B; *Salmonella Weltevreden*)
Residues of Veterinary medicinal products (antibiotics)	Furazolidone (AOZ); Nitrofurazone (SEM), Oxytetracycline, Chloramphenicol, Leucomalachite green

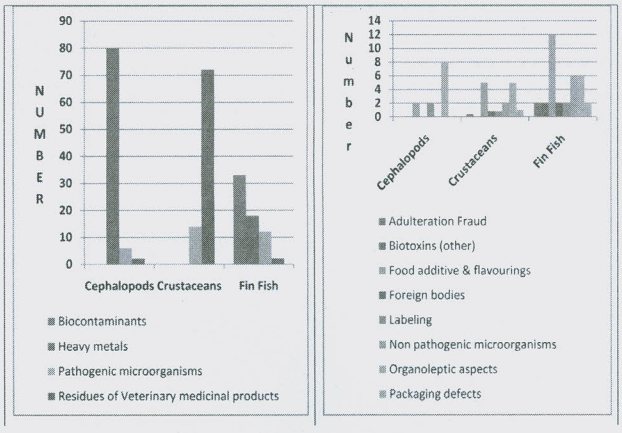

Fig 3.Species wise distribution of RASFF notifications of fish exported from India to the EU during 2001-2015.

Quality issues raised by the United States in fish imported from India

The United States has charged that the fish imported from India is subject to refusal of admission pursuant to Section 801(a)(3) in that such fish appears to contain Salmonella, a biological hazard which may render it harmful to health (OASIS charge code: Salmonella); or it appears to be adulterated in that it or contains a new animal drug (its metaabolites) that is unsafe (OASIS charge code – Vetdrugres) or it appears to consist in whole or in part of a filthy, putrid, or decomposed substance, (insect, rodent, and/or other animal filth), or to be otherwise unfit for food (OASIS charge code – Filthy). A total of 43 import refusals were reported in fish exported from India and were mainly due to presence of Salmonella, veterinary drugs and filth (Fig 3). Import refusals were reported in finfish, shrimp, crab, squid and octopus. Maximum quality issues were reported in fin fish (42%) followed by shrimp (30%). The antibiotics responsible for import alerts in shrimps were nitrofurans and chloramphenicol.

Specific quality issues

1.Residues of Veterinary medicinal products (antibiotics) in frozen shrimp:

The most important quality issue associated with frozen shrimp exported from India to EU and US is due to the residues of antibiotics. Maximum RASFF notifications due to antibiotics were observed during 2008 and 2009. However, notifications due to antibiotics were reported every year (Fig 4). The antibiotics reported were nitrofurans (Furazolidone (AOZ); Nitrofurazone (SEM)), Oxytetracycline and Chloramphenicol. Nitrofurans have by far been the most commonly detected antibiotic in frozen shrimp exported from India to EU and US.

RASFF notifications were due to nitrofurans in 100%,

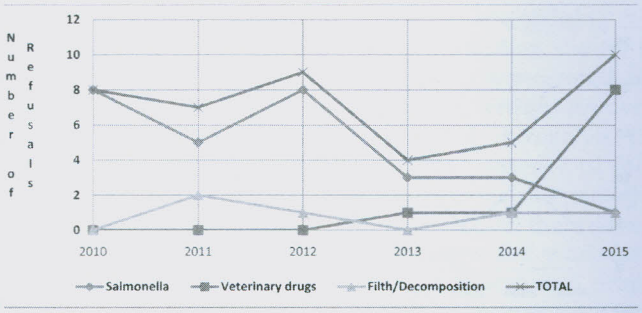

Fig 4. Trends in US import refusals pertaining to fish exported from India

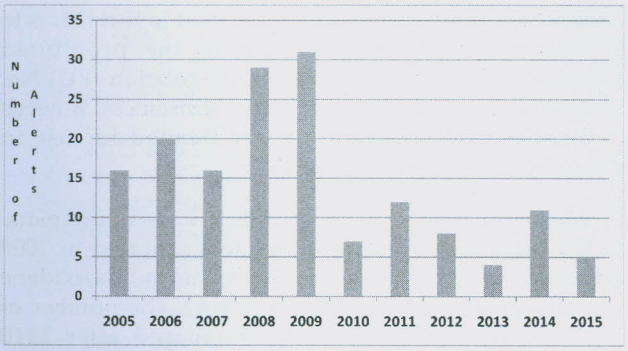

Fig 5. No. of alerts issued between 2005-2015

97% and 90% of *Machrobrachium rosenbergii, Penaeus monodon* and *L. vannamei* respectively. 87% of the RASFF notifications were due to the presence of nitrofuran metabolites (AOZ -47%, SEM-37% or both-3%).In the US, seven out of eight import refusals in frozen shrimp exported from India in 2015 were due to furazolidone and nitrofurazone, either alone or together. Nitrofurazone was mainly reported from frozen *M. rosenbergii* (Scampi) whereas Furazolidone was reported in *P. monodon* (black tiger) and *L. vannamei* shrimp.

Use of nitrofuran antibiotics were banned due to concerns of carcinogenicity of the drug residues and their potential harmful effects on human health. Nitrofurans parent compounds metabolise rapidly after ingestion by the shrimp to form corresponding tissue bound metabolites. Nitrofurazone metabolises to semicarbazide (SEM), Nitrofurantoin metabolizes to 1-aminohydantoin (AHD), Furaltadone metabolizes to 3-amino-5-morpholinomethyl-1,3-oxazolidinone (AMOZ) and Furazolidone metabolises to 3-amino-2-oxazolidinone (AOZ). The nitrofuran parent compounds have a short *in vivo* half life of 7 to 63 minutes results in the depletion of nitrofurans in blood and tissue of the shrimp but the nitrofuran metabolites (SEM, AHD, AMOZ and AOZ) bind to shrimp tissue proteins for many weeks after treatment. Nitrofuran metabolites are stable during storage and are not destroyed by cooking, frying, grilling, roasting and microwaving of meat. Nitrofurans are included in the USFDA high enforcement priority

Table 3. Pharmacologically active substances prohibited for use in food/aquaculture

EU Regulation on pharmacologically active substances regarding maximum residue limits in foodstuffs of animal origin (Prohibited substances)	USFDA High enforcement priority aquaculture drugs	INDIA Prohibited pharmacologically active substances in fish and fishery products
■ Chloramphenicol ■ Chloroform ■ Chlorpromazine ■ Colchicine ■ Dapsone ■ Dimetridazole ■ Metronidazole ■ Nitrofurans < Ronidazole	■ Chloramphenicol; ■ Nitrofurans; ■ Fluoroquinolones and Quinolones; ■ Malachite Green; ■ Steroid Hormones.	■ Nitrofurans including Furaltadone, Furazolidone, Nitrofurnatoin, Nitrofurazone ■ Chloramphenicol ■ Sulphamethoxazole ■ Aristolochia spp and preparations thereof ■ Chloroform ■ Chloropromazine ■ Colchicine ■ Dapsone ■ Dimetridazole ■ Metronidazole ■ Ronidazole ■ Ipronidazole and other nitromidazoles ■ Clenbuterol ■ Diethylstibestrol (DES) ■ Sulfanoamide drugs (except approved Sulfadimethoxine, Sulfabromomethazine and Sulfaethoxypyridazine)Glycopeptides

aquaculture drugs and are not to be used in fish that is to be consumed. Nitrofurans are in the prohibited substances list of the Commission Regulation (EU) No. 37/2010 on pharmacologically active substances. It needs to be noted that Nitrofurans are banned for use in aquaculture in India (EIC, 2012).

Maximum number of complaints in frozen shrimp due to the presence of nitrofurazone was reported in 2009 and maximum number of complaints due to furazolidone was reported in 2007 and 2008 (Fig 6). The number of SEM notifications drastically decreased after 2010 onwards which may mostly be attributed to the opinion that SEM may be present due to environmental contamination and therefore not be considered as sufficient proof for illegal use of veterinary medicines (RASFF, 2013) and also due to the drastic reduction in scampi exports from India. However, the complaints due to furazolidone continued in all the years (2005 to 2015)

2. Pathogenic microorganisms in fish exports:

Another major quality issue responsible for RASFF notifications was due to the presence of pathogenic microorganisms namely *Vibrio cholerae, Vibrio parahaemolyticus, Vibrio vulnificus* and Salmonella. During 2001-2015, pathogenic microorganisms were more commonly detected in crustaceans (n=36) compared to fin fish (n=6) and cephalopods (n=3). Pathogenic Vibrios (67%) were the dominant human pathogen detected followed by Salmonella (33%). Among the pathogenic vibrios, 78% of the alerts are due to the presence of either *V. cholerae* (including NonO1-nonO139 serogroups) or *V. parahaemolyticus* or both.

However, in the case of import refusals from US during 2010-2015 (n=43), Salmonella was the only pathogenic microorganism reported. Salmonella import refusals form 66% of the total import refusals during 2010-2015 with maximum refusals (n=8) in 2010 & 2012 and only one refusal in 2015. Item wise, Salmonella was reported more commonly in fish (42%) and shrimp (30%) which could be due to unhygienic handling of the fish product. The difference in the analytical procedure followed in the buyer country might have been another cause. The method of Salmonella analysis generally followed in India is to test 25g of fish sample for the presence of Salmonella. However, in US, a composite sample of 375g needs to be analysed (i.e. 15 analytical units each weighing 25 grams).

Measures to be adopted by the stake holders involved in fish production, processing, distribution, promotion and regulation to mitigate post-harvest quality issues in fish and fishery products exported from India are as follows.

Approaches to minimise the incidence of antibiotic residues in shrimp exports

Antibiotics used in humans should be avoided for use in aquaculture. Hatchery operators and shrimp farmers should be made aware of the banned antibiotics

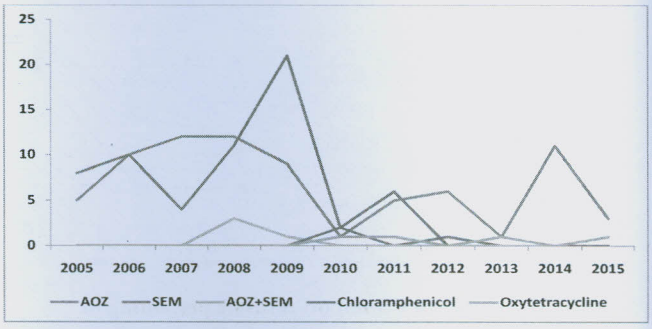

Fig 6. Trend in the RASFF complaints (antibiotic residue wise) of shrimp exported from India to European Union (SEM = semicarbazide; AOZ = 3-amino-2-oxazolidinone)

and the use of the same should be prohibited in shrimp rearing. It should be ensured that feed, feed supplements and medicines used in hatcheries are free from the banned antibiotics. Adoption of scientific farming practices (Good Aquaculture Practices, GAP) with appropriate stocking densities and water management need to be practiced. A record of all the inputs (feed, supplements, medicines) used should invariably be maintained in hatcheries and farms. Farm inputs without labels or extra label use of drugs must be avoided. Shrimp processors should accept and process only pre-harvest tested shrimp that were free from banned antibiotics. Establishing infrastructure for in-house testing for antibiotic residues and providing adequate training to the quality assurance personnel is an important part of GMP (Good Management Practices.) The processor should maintain effective traceability up to the pond level and conduct farm audits regularly to sensitise the farmers and suppliers on non-usage of banned antibiotics. Regulatory authorities should make it mandatory that all inputs used in shrimp hatcheries and shrimp aquaculture farms such as feed, probiotics, feed supplements and chemicals are tested and labeled as free from banned antibiotics. Extra label use of drugs, mainly furazolidone should be monitored. There is an urgent need to initiate a process for the compulsory registration of the personnel (technicians) involved in shrimp disease diagnosis and drug prescription for aquaculture, by a regulatory/statutory agency on the lines of MCI (medical practitioners) or VCI (veterinary practitioners).

Approaches to minimise the presence of pathogenic microorganisms in fish/shrimp exports

Hazard Analysis Critical Control Point system (HACCP) based approach from catch to consumption has to be enforced to avoid the entry and/or proliferation of pathogenic microorganisms. HACCP is a food quality management system to prevent hazards so that the food processed will be safe for human consumption. HACCP can be successfully implemented by educating food handlers on safe food production practices and ensure

strict adherence to hygienic practices. Maintaining cold chain from catch to processing/consumption should be ensured so as to maintain at <4°C till it is processed and delay in processing has to be avoided. Frozen products should be maintained at -18°C till it reaches the consumer. Adequate testing for the presence of food borne hazards has to be performed on the raw material, in-process material and the finished product there should be full commitment of the management and work force to ensure HACCP implementation at all stages. A proper system for pest control and waste management has to be put in place to prevent microbial entry and multiplication.

A paradigm shift in the consciousness of fish producers/harvesters and processors from 'quantity first' approach to 'quantity with quality' centric approach is needed for the supply of quality fish for domestic and export markets. The future of fisheries depends on the production of safe and wholesome products and this can be achieved by the strict adherence to HACCP based quality management practices during primary production/harvesting, processing, distribution and storage.

Conclusion

Systematic analyses of past rejections of each seafood exporting country provides much needed insight into the problems faced and plan for implementation of mitigation measures specific to the country so as to avoid recurrence of same problems in future and thereby helping sustainable and safe seafood exports.

Suggested References

Compendium of Orders of Fresh, Frozen and Processed Fish & Fishery Products and Compendium of Notifications of Fresh, Frozen and Processed Fish & Fishery Products, Export Inspection Council (Ministry of Commerce and Industry, Govt. of India) S.O. 729 (E) and S.O. 730 (E) dated 21st August 1995; http://www.eicindia.gov.in/

EIC (2012) List of antibiotics and pharmacologically active substances banned for use in aquaculture. Export Inspection Council (Ministry of Commerce and Industry, Govt. of India), Compiled on 03.1.2012, Page 7, http://www.eicindia.gov.in/Knowledge-Repository/Legal/Compendium-of-Order-Fish-Fihsery-Products.pdf

Food Safety and Standards (contaminants, toxins and residues) Regulations, 2011, Food Safety and Standards Authority of India, Ministry of Health and Family Welfare, Notification, New Delhi, dated the 1st August, 2011; http://www.fssai.gov.in/

MADHUSUDANA RAO, B. and PRASAD, M.M.. (2015) Residues of Veterinary Medicinal Products (antibiotics) in shrimp exported from India to the European Union (EU)-Trends in the last decade. Fishing Chimes, 34 **(10)** 6-11Fish and Fishery Products Hazards and Controls Guidance, Fourth Edition, April 2011, Department of Health and Human Services, Public Health Service, Food and Drug Administration, Center for Food Safety and Applied Nutrition Office of Food Safety, USA.

Regulation (EC) of the European Parliament and of the Council, Official Journal of the European Union (No 853/2004 - laying down specific hygiene rules for on the hygiene of foodstuffs); 854/2004- laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption and 2003/181/EC regards the setting of minimum required performance limits (MRPLs) for certain residues in food of animal origin); http://eur-lex.europa.eu/

RASFF notifications of EU. https://webgate.ec.europa.eu/rasff-window/portal/event Import alerts by the US Food and Drug Administration. http://www.fda.gov/ForIndustry/ImportProgram/ImportAlerts/default.htm

ICAR-CIFT, Cochin Organises Awareness Programme on Dolphins

ICAR-Central Institute of Fisheries Technology, Cochin organised a one day awareness workshop on "Protection of fishing nets from Dolphins attack using acoustic Pingers" at Chellanam fishing village of Ernakulam district on 21 December, 2016. The program was officially inaugurated by Dr. C.N. Ravishankar, Director, ICAR-CIFT,

Pinger is an acoustic instrument exclusively built to deter Dolphins approaching fishing nets and creating huge damages to nets and loss of catch. Pinger is designed to work by emitting a sound wave signal beyond 70 KHz that is known to be in the best hearing range of most Dolphin species. The signal acts as an alarm, and in some cases the Pinger stimulates dolphins to use their echolocation which alerts them to the presence of Pingers and fishing nets. Though this sound wave is not audible to human beings, it creates disturbances to dolphins and results in checking approach of dolphins near to fishing net. The Dolphin Pingers use a replaceable non-rechargeable Lithium Ion battery. The batteries in the Dolphin Pinger will last 12 months based on everyday use for 12 hours per day.

Dr M.P. Remesan, Principal Scientist, ICAR-CIFT proposed the vote of thanks. This was followed by a video presentation on ring seine fishing and use of acoustic Pingers and live demonstration about operations details. Nearly 90 fishermen from the villages adopted by ICAR-CIFT under the 'Mera Gaon Mera Gaurav' (MGMG) program actively participated in the programme and expressed their views and suggestions. ■